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Special Report

The Technological Gap: USSR Lags Behind the Developed West

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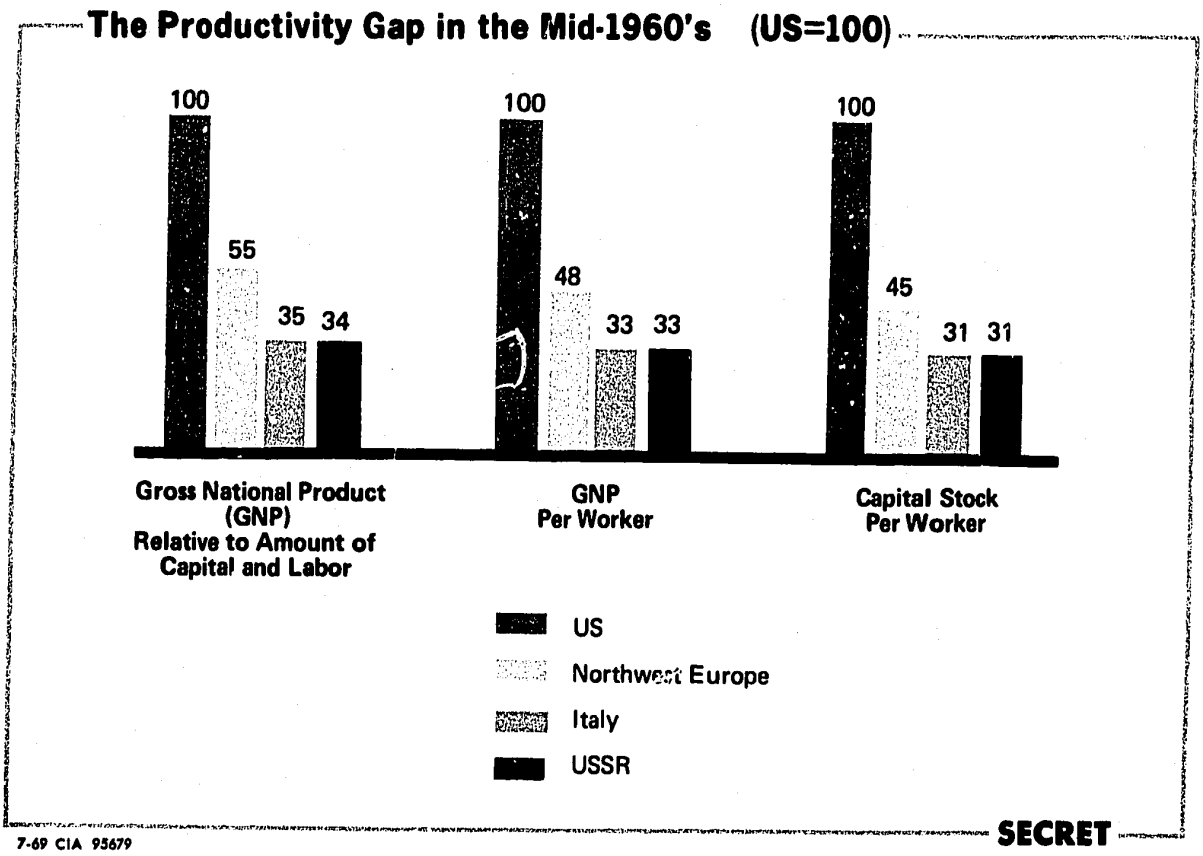
THE TECHNOLOGICAL GAP: USSR LAGS BEHIND THE DEVELOPED WEST

Throughout its industrialization drive the USSR has used every device available to keep abreast of world-wide developments in technology, while simultaneously maintaining a policy of cultural and political isolation at home. In the early 1930s the USSR borrowed technology from abroad on a massive scale via imports of machinery and equipment. After a period of retrenchment that lasted from the late 1930s until the mid-1950s, the USSR began to import technology once again from the industrial West. This time the Soviets supplemented trade in machinery and equipment with purchases of foreign patents and licenses, agreements and exchanges in the fields of science and technology, and the exploitation of foreign scientific and technical literature. Since 1955, they have concentrated on building a large domestic capability for the intensive development and application of technology.

Despite these efforts, the Soviet economy has not moved ahead in the post-World War II technological revolution as much as the economies of the developed West. Although the latest technology is employed in some areas—particularly in the defense and space industries—technology in use in the civilian economy generally lags far behind that of the West. This technological gap, moreover, may have widened during the 1960s. In recent years the Soviet leadership has undertaken various reforms in planning, incentives, prices and in the research and development establishment itself in order to speed the diffusion of technology throughout the economy. Closing the technological gap probably will remain an unattainable goal for the Soviets, however, without a change in the essentials of their present system of planning, priorities, and economic administration that have retarded innovation in the past.



MEASURING THE GAP

The Soviet technological lag is reflected in the large productivity gap that exists between the USSR and the developed West. Factor productivity is the measure of a country's output per unit of input of capital and labor. Although it is an inexact measure of the level of technology—it also measures such factors as differences in the quality of the labor force, management and natural endowments—it provides a reasonably approximate indication of the general size and trend of the gap over a period of time.

Chart on page 2 measures the Soviet productivity lag in the mid-1960s in three different ways: gross national production (GNP) per unit of labor and capital (factor productivity); GNP per worker (labor productivity); and value of capital stock per worker. All three measures indicate that the average level of technology in use in the Soviet economy is far below that of the US and also well below that of Western Europe.

Measuring the rates of growth of factor productivity in the USSR and the West reveals that the technological gap may have widened in the 1960s. The rate of productivity growth in the USSR exceeded that of the US during the 1950s (2.2 percent vs. 1.7 percent annually), but was well below the US in the 1960s (1.4 percent vs. 2.7 percent annually). The Soviet rate was also significantly below that of all the major countries of Western Europe except the United Kingdom during 1950-64. During 1960-64, moreover, the Soviet rate was less than half the rates achieved in all countries of Western Europe, including the UK. The postwar performance of Western Europe illustrates the catching up that could be expected of industrial countries which were temporarily behind in technology because of the war. The USSR was even further behind in the mid-1940s and has not caught up in the productivity sweepstakes, except in some areas of the military and space sectors.

The average level of technology in use in the industrial sector alone may be compared on a branch basis, as in table on page 7. Roughly speaking, Soviet technology probably comes closest to Western levels in machinery—including electronic and military equipment—and in metallurgy. It lags farthest behind in coal mining, forest products, textiles and clothing, and food processing.

Another measure of the relative technological levels of industrialized countries, at least in the manufacturing sector, is the nature and extent of their international trade in machinery and equipment. The machinery branch of industry is probably the most technologically intensive of the manufacturing sector. As industrialization proceeds, the large surplus of machinery imports over exports, which is characteristic of a developing country, tends to decrease as the country develops its capability to produce and sell machinery and equipment abroad.

The industrialized countries of the West and Japan carry on a large trade in machinery among themselves; each country is both a substantial importer and substantial exporter in this trade. The pattern of machinery trade for the USSR is completely different. There is a large gap between the share of machinery in total imports and its share in total exports in Soviet trade with the developed West: machinery makes up one third or more of total imports from these countries and a mere two to three percent of total exports to them. This large imbalance, which has remained essentially unchanged during the past decade, also persists, although to a lesser extent, in Soviet

trade in machinery with the industrialized countries of Eastern Europe–East Germany, Czechoslovakia and Poland.

REASONS FOR THE GAP

Education. Part of the international disparities in technological development reflects differences in educational attainment of the labor force, particularly in the supply of college-trained manpower. The USSR has made great efforts since 1950 to narrow the educational gap. Total Soviet expenditures on education have risen rapidly compared with the US: the USSR, with a GNP half that of the US, now spends about three fourths as much on education as does the US.

The average educational attainment of the labor force rose from about five years in 1950 to about seven years in 1968 and will probably reach about eight years in 1975. The average educational attainment of the US labor force was 10.7 years in 1950 and 12.3 years in 1967. The proportion of college graduates in the Soviet labor force, moreover, rose from 1.7 percent in 1950 to 4.6 percent in 1968; comparable figures for the US are 6.4 percent and 11.4.

Outlays for Research and Development. The US devoted about three percent of its GNP to research and development (R&D) in the mid-1960s compared with about 2.5 percent in the USSR. Both countries have allocated a rising share of their total output to research and development during the past decade. One measure of a country's R&D activities is the extent to which its scientific and engineering manpower is engaged in that effort. In the mid-1960s the US had about the same number of scientists and engineers employed in R&D as did the USSR.

Although the relative size of R&D efforts in the US and USSR compared to their respective resource bases appears similar, the US has devoted a larger proportion to the civilian sector. In addition, the US has allocated a considerably larger share of its total R&D outlays to development work as against basic research than has been the case in the USSR. This emphasis on applied research generally facilitates the rapid translation of theoretical research findings into new products and improved production processes.

Diffusion of New Technology. In market economies, private enterprises are the innovators in the development and diffusion of new technology. Governments encourage and help finance this process but, for the most part, are not the prime movers. Even in the military field, where governments are the only customers, competition among potential contractors serves to induce technological advance. This also encourages spinoffs of military-space technology to the civilian sector. Finally, multinational firms greatly facilitate the diffusion of technology and managerial know-how abroad by investing in foreign subsidiaries.

In the centrally administered economy of the USSR, however, new production techniques and products must be "introduced" by deliberate actions of the administration bodies; obsolete technology and old products must be taken out of use or production in the same way. There is no automatic mechanism for fostering technological progress, and the incentives devised to stimulate innovation have been ineffective.

Soviet enterprises introduce new technology and turn out new products according to annual

and long-range plans. The innovations incorporated in these plans usually are not developed by the local enterprises but by research and design institutes attached to industrial ministries. The whole process must then be coordinated along the chain of command. As a result, innovations come much less frequently and are spread much more slowly than in the West.

An even greater barrier to rapid technological advance than a cumbersome bureaucracy is the resistance of enterprise management to innovation because of the USSR's faulty incentive system. Until recently, the main success criterion for enterprises was the fulfillment of production plans; bonuses for managerial personnel were keyed to this indicator. As a result, managers were reluctant to innovate because interrupting production processes to incorporate new technology threatened plan fulfillment and bonuses. A further restraint was the practice of increasing plan assignments once an innovation had been adopted. In addition to resisting the incorporation of new technology into their plans, plant managers delayed introducing new measures that had become part of the plan, often by claiming that their plants failed to receive the required materials and equipment in time.

Another obstacle to innovation in the USSR has been distortions in the price system. Soviet prices do not provide an accurate guide to choice based on efficiency because they are centrally fixed, inflexible, and based on industry-wide average costs. For years Soviet planners have tried various formulas to calculate the effectiveness of new investment, but none have been found satisfactory. Until very recently, for example, capital costs were largely ignored and amortization charges were purely arbitrary.

Different Priorities. The wide disparities in technological advance among the branches of Soviet industry vis-a-vis the West directly reflect the long-standing priorities of the leadership. First priority traditionally has been accorded to the defense establishment. The military has had first claim on resources—the brightest scientists and engineers, the most skilled workers, the highest quality materials and equipment, and the best construction talent. Another advantage has been a clear-cut, single-minded goal: an image of equality with the US in defense and space. The military space sector has flourished under this favoritism and has achieved near-technological parity with the US in many types of weapons and space equipment.

The basic industries—steel, fuels, electric power, producers' equipment, and, more recently, chemicals—have received second priority even though their output directly supports both military production and the investment programs essential to over-all economic growth. The industries serving the population—textiles and clothing, food processing, consumer durables, and household products—have been lowest on the scale of priorities.

EFFORTS TO CLOSE THE GAP

The Soviet leadership hopes to achieve a breakthrough in developing and introducing new technology through a number of major economic reforms. Some of these have been introduced over the past three years and others are still in the process of implementation.

A revision of planning and incentives, launched by Premier Kosygin in late 1965, now has been extended to most of the industrial

sector. This reform broadens the authority of enterprise managers in plan formulation, establishes sales or profits and the return on invested capital as the main success criteria for enterprises and as the basis for incentive payments, and levies an interest charge on invested capital. The new profits criteria and capital charge are intended to encourage enterprises to reduce costs by adopting new technology and scrapping obsolescent equipment. The emphasis on sales and profits, in place of gross output, is designed to spur the output of new and improved products.

The new measures have had little effect thus far, and are unlikely to be very effective in the future since the Kosygin reform retains many of the features that have inhibited innovation in the past—centrally fixed plans for output, investment, and new technology; central allocation of key materials and machinery; and the continuation of success criteria for enterprises based on fulfillment of plans. Great emphasis continues to be placed on "tight" plans, moreover, and enterprise plan assignments are still boosted after technological improvements have been adopted. Finally, the rights granted enterprise managers have been curtailed by the ministries through direct interference and the imposition of detailed rules and regulations.

Enterprise managers are unlikely to be more eager to adopt new technology than before the reform since their bonuses are still linked to plan fulfillment. Because of the perverse price system, the charge on capital may even lead managers to avoid the purchase of new machinery, whose payoff remains difficult to determine. In fact, the reform has complicated decision-making at the enterprise level because the new success criteria are inconsistent while many of the old regulations have been retained. Thus innovation will not be fostered automatically by the new so-called "economic levers" but will continue to require "introduction" by the planners.

In recent years the USSR has adopted a new set of industrial prices and a revised system of price formation. The new prices are generally higher and for the first time include an allowance for producers to pay interest on capital. Price committees were established and explicitly charged with "raising the role of prices in promoting technological progress in all of its many-sided aspects."

Press discussion indicates that the committees are tackling their task with a missionary zeal, attempting to set prices in great detail. Prices for individual machines and equipment are to be set so as to encourage enterprises to buy new machines and discard old equipment, and prices on consumer goods and industrial materials will be juggled to accomplish the same objective. Prices on new products will be set high enough to encourage their production, but not too high to discourage their purchase. The over-all result of these machinations probably will further complicate the decision-making process and increase bureaucratization of the system.

In October 1968 the government issued guidelines for extensive changes in the organization and incentives of the research and development establishment. In effect, the decree extends the principles of the industrial economic reform to the R&D sector. Wages and bonuses for individual scientists and the profits of research institutes will be based in part on the economic effectiveness of their work.

The success of these reforms in the long run may be limited by bureaucratic inertia and a reluctance to implement some of the proposals. Academy and university research institutes are likely to resent the planned periodic review of their economic effectiveness. In the past the Soviet R&D community has enjoyed a great deal of independence in the absence of economic success indicators and accountability. If the reform of the R&D establishment is successfully implemented, however, it should encourage a greater emphasis on applied research and promote a more speedy introduction of new technology into industry. *(SECRET)*

Comparison of Soviet and Western Technology in Major Branches of Industry

AIRCRAFT

High-performance fighters and interceptors are comparable with those in the West, but civil transport is generally inferior in range, payload, fuel consumption, and engine life.

COMPUTERS

Soviet technology for producing computers, peripheral equipment, and solid-state electronic components is behind that of the West by at least five years, and the gap is widening. Communications satellite technology lags 3-5 years behind the West and is likely to remain so for the foreseeable future.

MACHINE TOOLS

The Soviet stock of machine tools is considerably younger than in the US but its composition is inferior because of poor quality and the preponderance of standardized general purpose tools.

AUTOMOBILES AND TRACTORS

Both the production technology and the product mix in the Soviet automotive and tractor industry are obsolescent compared with the West.

PETROLEUM

The USSR lags well behind the UK in this sector, by as much as 10 years in seismic exploration and offshore drilling.

STEEL

Soviet blast furnace technology is approximately on a par with the West, but only 12 percent of Soviet steel is made by the modern oxygen converter process, compared with over one-fourth in Western Europe and over one-third in the US. Soviet rolling and finishing facilities are grossly inadequate and technologically inferior to those in the West.

HYDROELECTRIC AND THERMAL POWER

The USSR leads the world in construction of hydroelectric power plants and in high-voltage long-distance transmission. Soviet thermal power engineering, however, lags at least five years behind the US both in size of units and in other technology.

COAL MINING

Soviet longwall technology lags behind that of the US and West Germany, where natural conditions are comparable, and is behind both the US and Western Europe by a decade or more in mechanical loading, mechanization of surface work, and coal preparation techniques.

CHEMICALS

The Soviet chemical industry is at least five years behind the West in the technology used to produce most important chemicals, and its product mix with its relatively small production of synthetics is obsolescent.

CONSUMER GOODS

The food industry of the USSR, with the exception of bread production, is a generation behind the West. Soviet textile mill equipment is 25-30 years behind that of the US. Soviet appliances and housewares, often produced as sidelines in heavy machinery and aircraft plants, are mainly copies of obsolete Western models.

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